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January 2000



Mathematics 33
Grade 12 Diploma Examination

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January 2000

Mathematics 33

Grade 12 Diploma Examination

Description

Time: This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 37 multiple-choice and 12 numerical-response questions, of equal value, worth 70% of the examination
- 4 written-response questions worth 30% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

A mathematics data booklet is provided for your reference.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.*

Instructions

- You are expected to provide your own scientific calculator.
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Learning.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

- A.** biology
B. physics
C. chemistry
D. mathematics

Answer Sheet

(A) (B) (C) ☒

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.7), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

Examples

Calculation Questions and Solutions

The value of $\tan 35^\circ$ to the nearest tenth is

(Record your answer in the numerical-response section on the answer sheet.)

Calculator value: 0.7002075

Value to be recorded: 0.7

Record 0.7 on the answer sheet —

0	.	7	
	●	●	
●	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	●	7
8	8	8	8
9	9	9	9

The constant term in the quadratic function $y = 2x^2 + 7x + 32$ is _____.

(Record your answer in the numerical-response section on the answer sheet.)

Value to be recorded: 32

Record 32 on the answer sheet

3	2		
---	---	--	--

.	.		
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Correct-Order Question and Solution

Four angles given below are to be drawn on a coordinate plane in standard position.

- 1 750°
- 2 650°
- 3 460°
- 4 845°

When the principal angles corresponding to the above angles are arranged in order from **lowest** to **highest**, then the order is _____, _____, _____, _____.

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Value to be recorded: 1342


Record 1342 on the answer sheet

1	3	4	2
---	---	---	---

.	.		
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Written Response

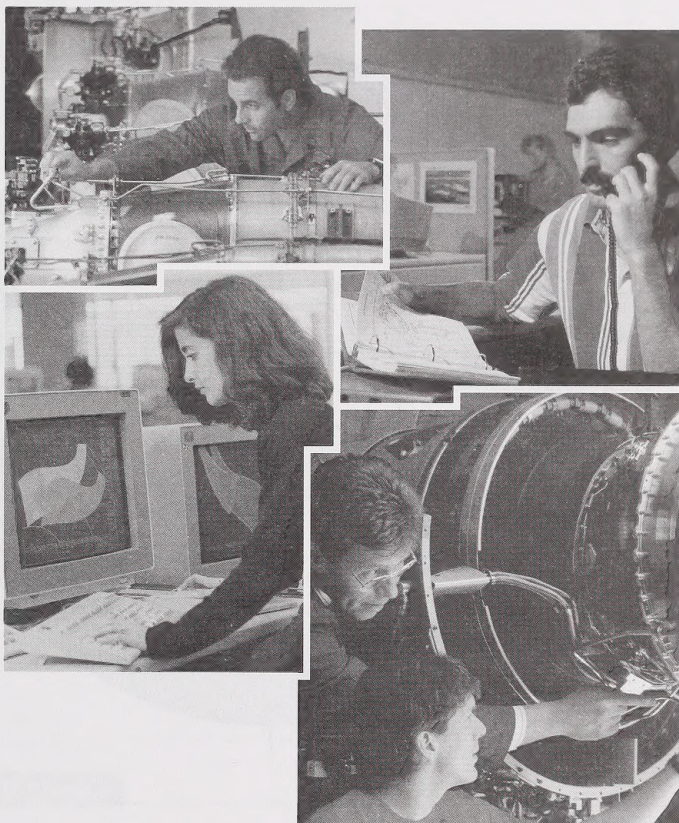
- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your answers must be presented in a well-organized manner using complete sentences and correct units.



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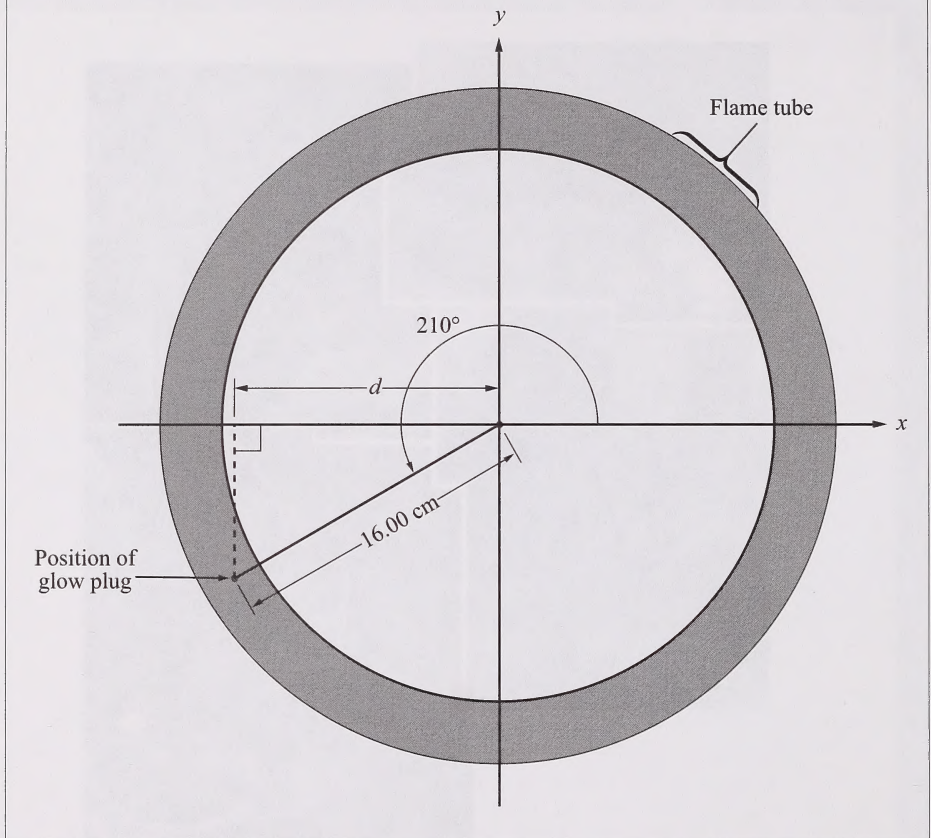
AIRCRAFT INDUSTRY

Mathematics is used extensively in the operation, maintenance, and financing of various aircraft engines. The next set of questions is related to the aircraft engine industry.



Use the following information to answer the first question.

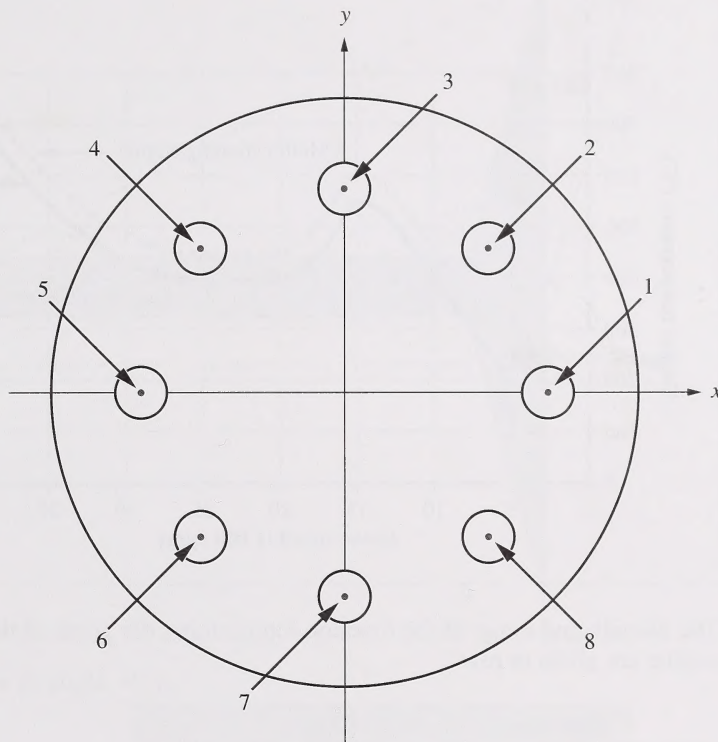
A technician checked the position of a glow plug located 16.00 cm from the centre of a flame tube in a helicopter engine, as shown in the cross section below.



1. In the diagram above, the length of d , to the nearest hundredth of a centimetre, is
- A. 16.00 cm
 - B. 13.86 cm
 - C. 9.24 cm
 - D. 8.00 cm

Use the following information to answer the next question.

The propeller mount for an aircraft engine has 8 equally spaced holes, as shown in the diagram below. Each hole is numbered and its centre corresponds to an angle in standard position.



Numerical Response

1. Match the holes, as numbered above, with their corresponding angle below.

Angle Hole Number

45° _____ (Record in the **first** column.)

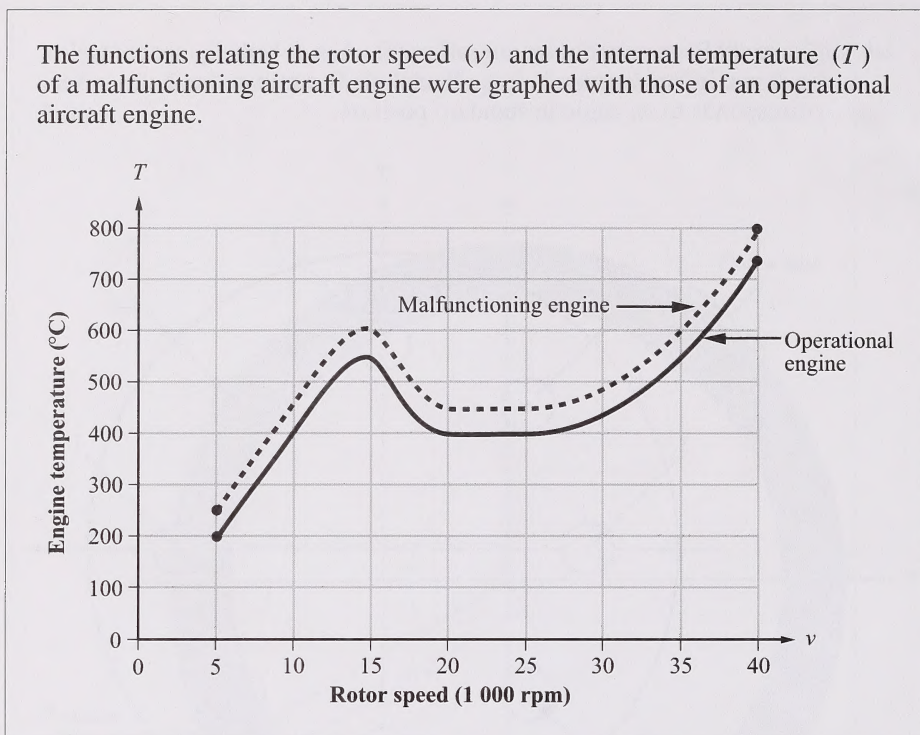
180° _____ (Record in the **second** column.)

225° _____ (Record in the **third** column.)

270° _____ (Record in the **fourth** column.)

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next two questions.



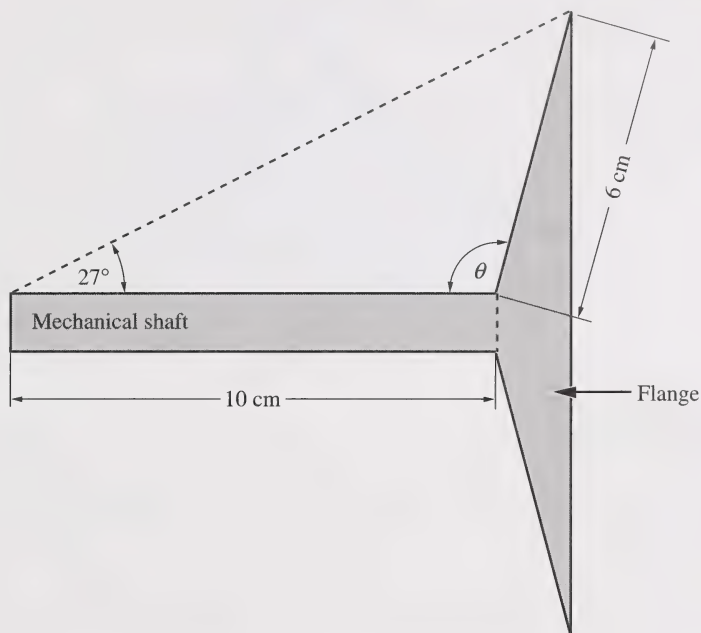
2. The domain and range of the function representing the graph of the operational engine are given in row

	Domain	Range
A.	$250 \leq T \leq 800$	$5\,000 \leq v \leq 40\,000$
B.	$200 \leq T \leq 750$	$5\,000 \leq v \leq 40\,000$
C.	$5\,000 \leq v \leq 40\,000$	$250 \leq T \leq 800$
D.	$5\,000 \leq v \leq 40\,000$	$200 \leq T \leq 750$

3. To transform the graph corresponding to the operational engine into the graph corresponding to the malfunctioning engine, there would need to be a
- A. vertical shift of $+50^\circ\text{C}$
 - B. vertical shift of -50°C
 - C. horizontal shift of $5\,000\text{ rpm}$
 - D. horizontal shift of $-5\,000\text{ rpm}$

Use the following information to answer the next question.

On an airplane, an engineer needed to determine the angle between a mechanical shaft and its attached flange, as shown in the diagram below.

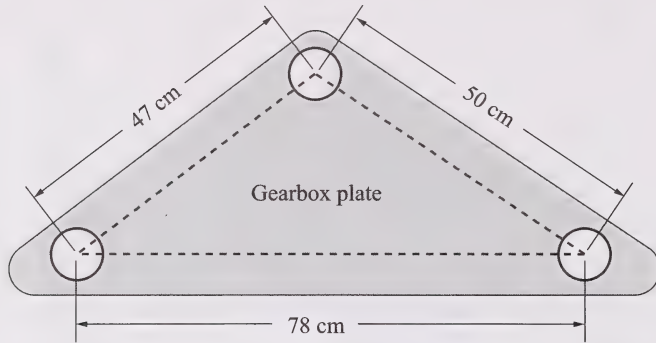


4. The measure of angle θ is

- A. 49°
- B. 101°
- C. 104°
- D. 137°

Use the following information to answer the next question.

A machinist measured the distances between the centres of the three holes in the face of a plane's gearbox plate, as shown below.



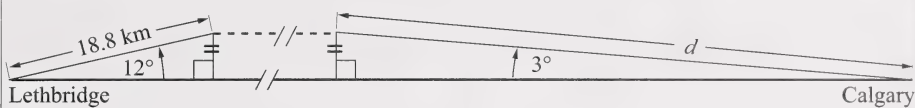
Numerical Response

2. The machinist then determined that the measure of the angle between the two shortest distances from the centres of the three holes, to the nearest degree, is _____°.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

In order to evaluate a repaired engine, a flight technician took an aircraft for a test flight. The plane took off from the Lethbridge airport and climbed at an angle of 12° for 18.8 km. It then travelled horizontally at a fixed altitude. Later, the plane descended into Calgary International Airport at an angle of 3° , as shown below.



5. The distance, d , that the plane travelled while descending is
- A. 18.8 km
 - B. 39.1 km
 - C. 74.7 km
 - D. 76.2 km

Use the following information to answer the next question.

To check the efficiency of one of the compressors in an aircraft engine, a technician used the formula

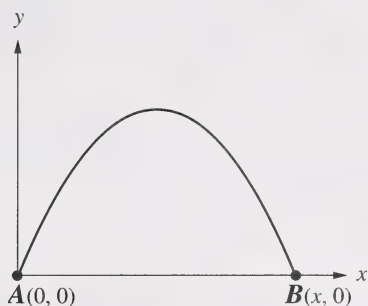
$$E = \left(\frac{390 - I}{F - I} \right) \times 100,$$

where E is the efficiency of the compressor as a percentage, I is the initial air temperature in kelvins (K), and F is the final air temperature in kelvins (K).

6. To maintain an efficiency, E , of 65% in a compressor where the initial air temperature, I , is 296 K, the final air temperature, F , to the nearest tenth of a kelvin, would have to be
- A. 297.4 K
 - B. 365.1 K
 - C. 440.6 K
 - D. 600.0 K

Use the following information to answer the next question.

An aircraft engine manufacturing facility has a roof shaped like a parabola that can be graphed as the function $f(x) = -0.12(x - 10)^2 + k$, as shown below.



7. The vertex of the graph of the function is

- A. $(10, k)$
- B. $(10, -k)$
- C. $(-10, k)$
- D. $(-10, -k)$

Use the following information to answer the next question.

To expand an aircraft engine manufacturing facility, management purchased some land by obtaining a mortgage of \$156 000 over 15 years at 6.25% per annum.

8. The monthly payment on this mortgage is

- A. \$1 310.22
- B. \$1 330.80
- C. \$1 351.54
- D. \$1 523.90

Use the following information to answer the next question.

An employee at an aircraft manufacturing facility plans to retire in two years and is considering two different savings plans to prepare for retirement.

Option One requires him to deposit \$1 800 into an account at the beginning of every six-month period. This investment will earn interest at 9% per annum, compounded semi-annually.

Option Two requires him to deposit \$900 into an account at the beginning of every three-month period. This investment will earn interest at 10% per annum, compounded quarterly.

Tables for both options are illustrated below.

Option One				
Period	Previous Amount	Deposit per Period	Interest at 4.5% per Period	Final Amount
1		\$1 800.00	\$81.00	\$1 881.00
2	\$1 881.00	\$1 800.00	\$165.65	\$3 846.65
3	\$3 846.65	\$1 800.00	\$254.10	\$5 900.75
4	\$5 900.75	\$1 800.00		A

Option Two				
Period	Previous Amount	Deposit per Period	Interest at 2.5% per Period	Final Amount
1		\$900.00	\$22.50	\$922.50
2	\$922.50	\$900.00	\$45.56	\$1 868.06
3	\$1 868.06	\$900.00	\$69.20	\$2 837.26
4	\$2 837.26	\$900.00	\$93.43	\$3 830.69
5	\$3 830.69	\$900.00	\$118.27	\$4 848.96
6	\$4 848.96	\$900.00	\$143.72	\$5 892.68
7	\$5 892.68	\$900.00	\$169.82	\$6 962.50
8	\$6 962.50	\$900.00		B

Written Response—5 marks

1. a. The employee's **deposit per period** for Option One is \$_____, and for Option Two, it is \$_____.

- b. Determine the **final amounts** A and B , and show how you obtained these values.

- c. Which investment option would you recommend to this employee?
Explain your reasons.

CONNECTIONS

Procedures used to simplify polynomials and fractions can be used to simplify rational and radical expressions. Use these connections to solve the following set of questions.

9. The expression $\frac{k-2}{k^2+k-6}$, where $k \neq -3$ or 2 , is equivalent to
- A. $\frac{1}{k+3}$
- B. $\frac{1}{k-3}$
- C. $\frac{1}{k^2-3}$
- D. $\frac{1}{k^2+3}$
10. A simplified form of $\frac{x^2+3x-10}{x^2-4} \times \frac{x^2+5x+6}{x^2+5x}$, where $x \neq 2, -2, -5$, or 0 , is
- A. $x+3$
- B. $\frac{x+3}{x}$
- C. $\frac{x}{x+3}$
- D. $\frac{(x+3)(x+2)}{x-2}$

11. If the rational expression $\frac{3}{x+4} + \frac{x+5}{x+6}$, where $x \neq -4$ or -6 , is written as a single fraction, then the numerator could be
- A. $x + 8$
 - B. $3x + 8$
 - C. $x^2 + 6x + 19$
 - D. $x^2 + 12x + 38$

Use the following information to answer the next question.

A student attempted to solve the rational equation $\frac{6\,000}{x} - \frac{6\,000}{x-200} = 8$, where $x \neq 0$ or 200 , by completing the following steps.

Step I $6\,000(x-200) - 6\,000x = 8$

Step II $6\,000x - 1\,200\,000 - 6\,000x = 8$

Step III $-1\,200\,000 = 8$

Step IV There is no solution for x .

12. The **first** error that the student made occurred in
- A. step I
 - B. step II
 - C. step III
 - D. step IV

Numerical Response

3. The **largest** non-permissible value of x for the equation $\frac{6\,000}{x} - \frac{6\,000}{x-200} = 8$ is _____.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

The conversion of a second-order radical to a mixed radical is shown below.

$$\begin{aligned}\sqrt{50} &= \sqrt{25} \times \sqrt{2} \\ &= 5\sqrt{2}\end{aligned}$$

A similar process can be used to convert the third-order radical $\sqrt[3]{24}$ to the mixed radical $a\sqrt[3]{b}$, where a and b are whole numbers greater than 1.

13. If $\sqrt[3]{24}$ is converted to $a\sqrt[3]{b}$, then the value of b is

- A. 2
 - B. 3
 - C. 6
 - D. 8
-

Numerical Response

4. If the expression $\sqrt{8} - \sqrt{50} + \sqrt{32} + \sqrt{18}$ is simplified to the form $a\sqrt{2}$, then the value of a is _____.

(Record your answer in the numerical-response section on the answer sheet.)

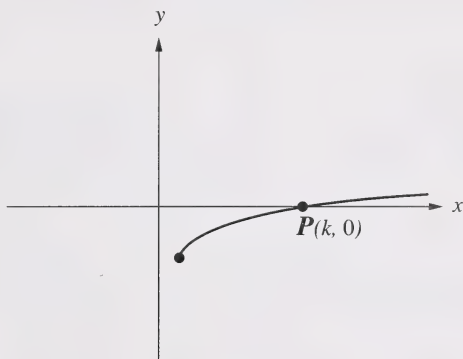
Numerical Response

5. When the radical expression $\frac{15\sqrt{3}}{\sqrt{5}}$ is simplified to the form $m\sqrt{n}$, where m and n are both whole numbers greater than 1, the value of n is _____.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

The graph of the function $y = \sqrt{x - 1} - 2.5$, where $x \geq 1$, passes through point $P(k, 0)$, as shown below.



To solve for k , a student let $y = 0$ in the function and wrote $0 = \sqrt{k - 1} - 2.5$.

14. The value of k is

- A. 2.50
- B. 3.50
- C. 6.25
- D. 7.25

ALBERTA INDUSTRY

People involved in the coal industry in Alberta use mathematics to make business decisions, improve daily operations, and address environmental concerns. The following questions are related to these applications.



Use the following information to answer the next question.

To determine public awareness of the use of coal in generating electricity, a researcher randomly selected 40 people from a town and asked them, “Is coal used to generate your power?”

Of the 40 people surveyed, 16 said “yes.”

15. Based on this sample of 40 people, the 90% confidence interval for the percentage of all people in this town who said that their power is generated by coal is between
- A. 15% and 25%
 - B. 25% and 60%
 - C. 30% and 50%
 - D. 60% and 90%
-

Use the following information to answer the next question.

At the beginning of each year, an employee working at a coal mine contributes \$1 200 into an annuity, and the coal company contributes an additional \$4 200 into the same annuity.

16. If this total annual contribution were made for 35 years and the annuity earned interest at 6% per annum compounded annually, then the total amount in the employee’s annuity, to the nearest cent, would be
- A. \$13 230.00
 - B. \$78 290.55
 - C. \$200 340.00
 - D. \$637 852.70

Use the following information to answer the next question.

The mining company financed the purchase of a coal truck by taking out a loan of \$200 000 to be repaid over 5 years. The monthly payments on the loan were \$3 936.70.

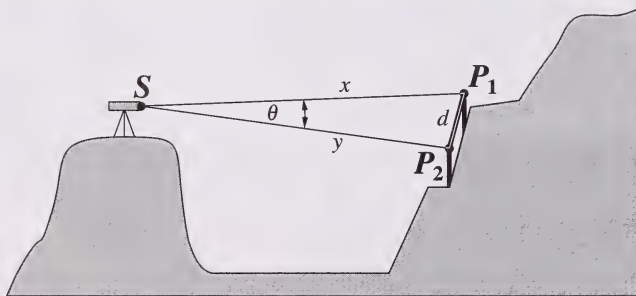
Numerical Response

6. The annual rate of interest on this loan, to the nearest **hundredth** of a percentage, is _____%.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

The stability of a wall in a coal mine pit can be measured by determining the distance, d , that a prism marker shifts on a bench (ledge) in the pit. A surveyor used a laser positioned at point S to find the distance that the marker moved from point P_1 to point P_2 , as shown below.



17. The distance, d , can always be determined by using the equation

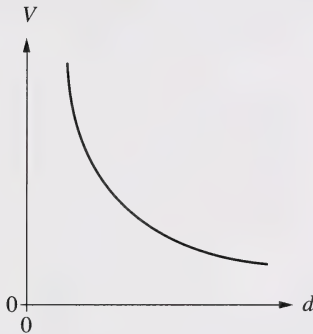
- A. $d = x \sin \theta$
- B. $d = y \tan \theta$
- C. $d = \sqrt{x^2 + y^2 - 2xy(\cos \theta)}$
- D. $d = \sqrt{x^2 + y^2 - 4xy(\cos \theta)}$

Use the following information to answer the next question.

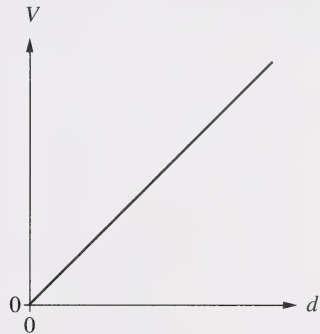
At a particular mining site, coal trucks haul coal from various pits to the processing plant. The volume, V , of coal that can be hauled during a shift is related to the distance, d , from the pit to the plant. The closer that the pit is to the plant, the more coal that can be hauled during a shift.

18. Which of the following graphs could illustrate this relation?

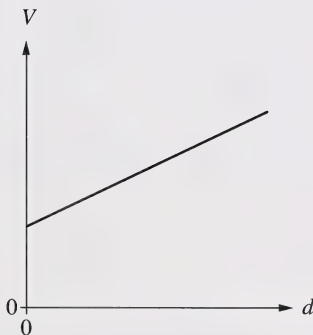
A.



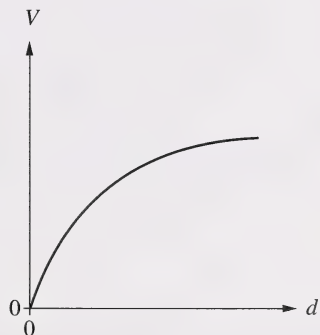
B.



C.

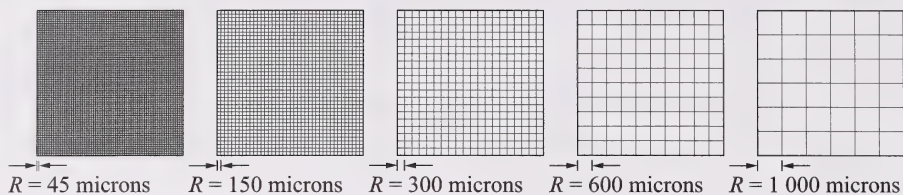


D.



Use the following information to answer the next question.

At a processing plant, high-quality coal is collected by passing crushed coal through different grades of meshed screens, as shown below.



The percentage, P , of coal passing through a screen is related to the square root of the width in microns, R , of the mesh opening.

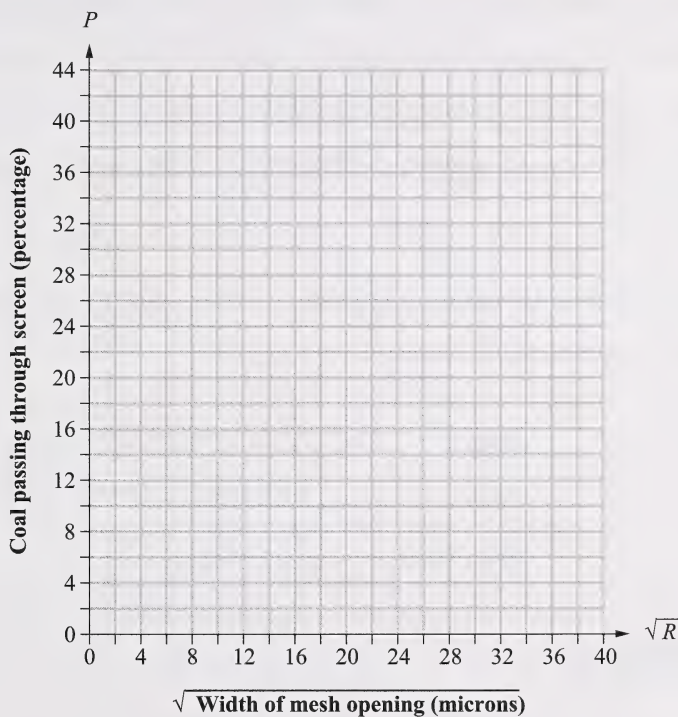
A technologist collected some data to calculate \sqrt{R} for specific values and constructed the following table.

R (in microns)	\sqrt{R} (to the nearest tenth)	P (in percent)
0	$\sqrt{0} = 0$	0.0
45	$\sqrt{45} = 6.7$	8.7
150	$\sqrt{150} = 12.2$	15.9
300	$\sqrt{300} = 17.3$	22.5
600	$\sqrt{600} = 24.5$	31.9
1 000		41.1

Written Response—6 marks

2. a. Complete the last row of the table above by calculating the missing value of \sqrt{R} to the nearest tenth.

- b. On the grid below,
- plot the six points corresponding to the data relating \sqrt{R} and P
 - draw a line beginning at $(0, 0)$ that best represents your six plotted points



- c.
- Determine the slope, m , of your line of best fit to the nearest tenth.
 - Write the equation representing your line of best fit in the form $y = m\sqrt{R}$.
 - Determine the percentage, P , to the nearest tenth of a percentage, of coal passing through a screen where R is 2 000 microns.

Use the following information to answer the next question.

To determine the depth and contour of the coal seam below the floor of a coal mine pit, three holes are drilled such that if they were connected, the resulting shape would be that of an equilateral triangle. The total area, A , in metres squared, over which this shape would lie can be found by using the formula $A = \sqrt{1.5s(1.5s - s)^3}$, where s is the distance in metres between any two holes.

If the distance s between any two holes is 3.5 m, then two of the three steps used to find the area, A , are shown below.

$$\text{Step I} \quad A = \sqrt{(1.5 \times 3.5)(1.5 \times 3.5 - 3.5)^3}$$

$$\text{Step II} \quad A = \sqrt{5.25(5.25 - 3.5)^3}$$

$$\text{Step III} \quad A = \underline{\hspace{2cm}}$$

Numerical Response

7. The area, A , to the nearest tenth of a metre squared, is _____ m^2 .

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

To calculate the hydraulic conductivity, K , of water being pumped out of a layer of porous rock that is above a coal mine pit, an engineer uses the function $K = \frac{94\,000}{d}$, where d is the thickness of the rock in metres.

19. The inverse of the function $K = \frac{94\,000}{d}$ can be written as
- A. $d = \frac{94\,000}{K}$
- B. $d = \frac{K}{94\,000}$
- C. $d = 94\,000K$
- D. $d = 94\,000 + K$
-

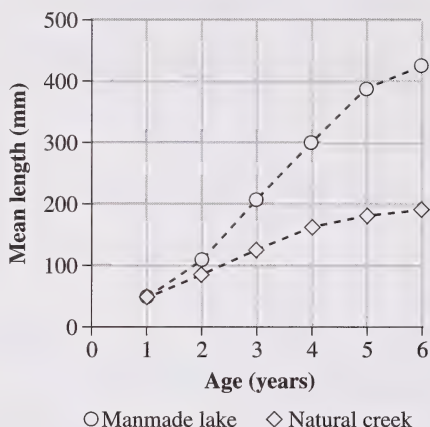
Use the following information to answer the next question.

Coal mining companies use helicopters to reseed mined areas. One particular $200\,000\text{ m}^2$ area to be reseeded is rectangular in shape, and its length is 800 m longer than its width.

20. If the width of this area, in metres, is represented by x , then an equation that could be used to determine the area is
- A. $x^2 + 800x = 0$
- B. $800x^2 - 200\,000 = 0$
- C. $x^2 + 800x + 200\,000 = 0$
- D. $x^2 + 800x - 200\,000 = 0$

Use the following information to answer the next question.

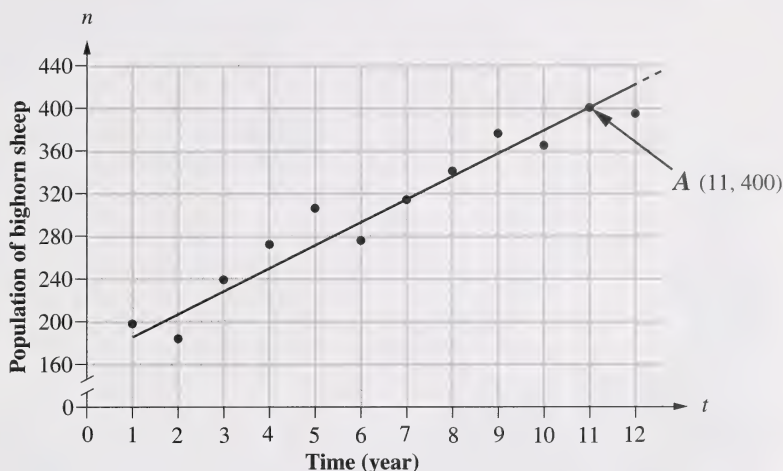
Coal mining companies conduct studies to compare wildlife growth rates in natural areas with those that have been reclaimed after mining. The graph below compares the age and the mean length of trout in a natural creek with those in a manmade lake.



21. Which of the following statements **best** represents the information presented above?
- A. The growth rate of trout in the natural creek stays the same as the age of the trout increases.
 - B. The growth rate of trout in the manmade lake is the same as the growth rate of trout in the natural creek.
 - C. The growth rate of trout in the manmade lake is higher than the growth rate of trout in the natural creek.
 - D. The growth rate of trout in the natural creek is higher than the growth rate of trout in the manmade lake.

Use the following information to answer the next two questions.

Over a twelve-year period, a coal mining company analyzed the bighorn sheep population in a mining area, as shown in the scatter plot below. A line of best fit has been included.



The correlation for the graph is positive, which means that as time increases, the population of the bighorn sheep increases.

22. The row that completes the statement above is row

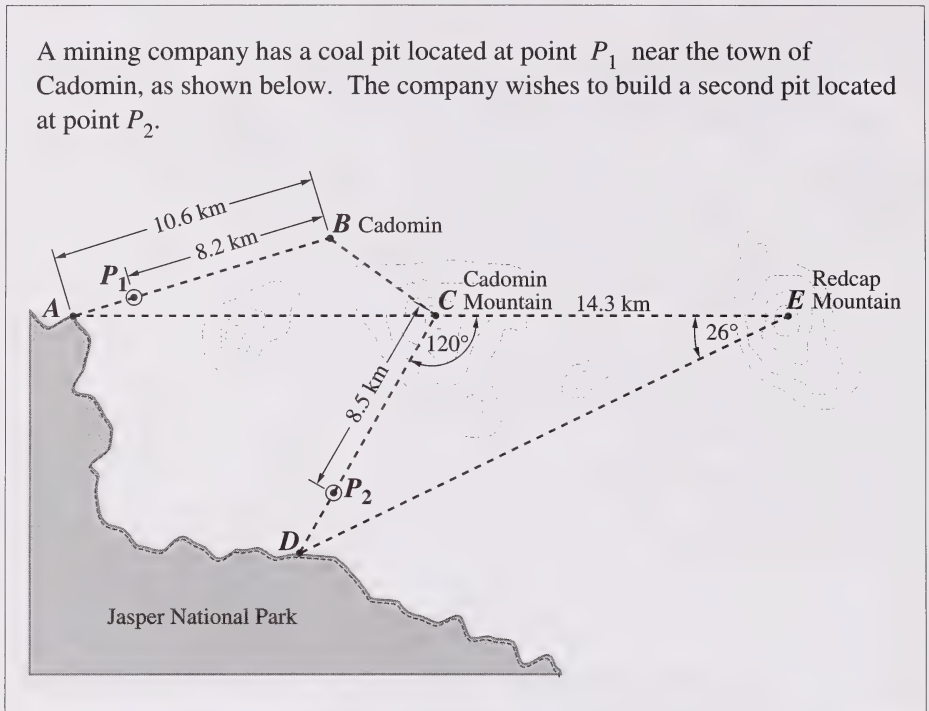
	<i>i</i>	<i>ii</i>
A.	positive	decreases
B.	positive	increases
C.	negative	increases
D.	negative	decreases

Numerical Response

8. According to the line of best fit, the annual growth rate of the bighorn sheep population is 21 sheep per year. Knowing this and using point A(11, 400) on the graph, the mining company predicted that in year 15, the bighorn sheep population will **most likely** be _____ sheep.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.



Written Response—5 marks

3. a. From point A on the perimeter of Jasper National Park, the distance to the pit at point P_1 , to the nearest tenth of a kilometre, is _____ km.

Use the following additional information to answer the next part of this question.

Government regulations indicate that the pit to be located at P_2 cannot be any closer to Jasper National Park than the pit currently located at P_1 .

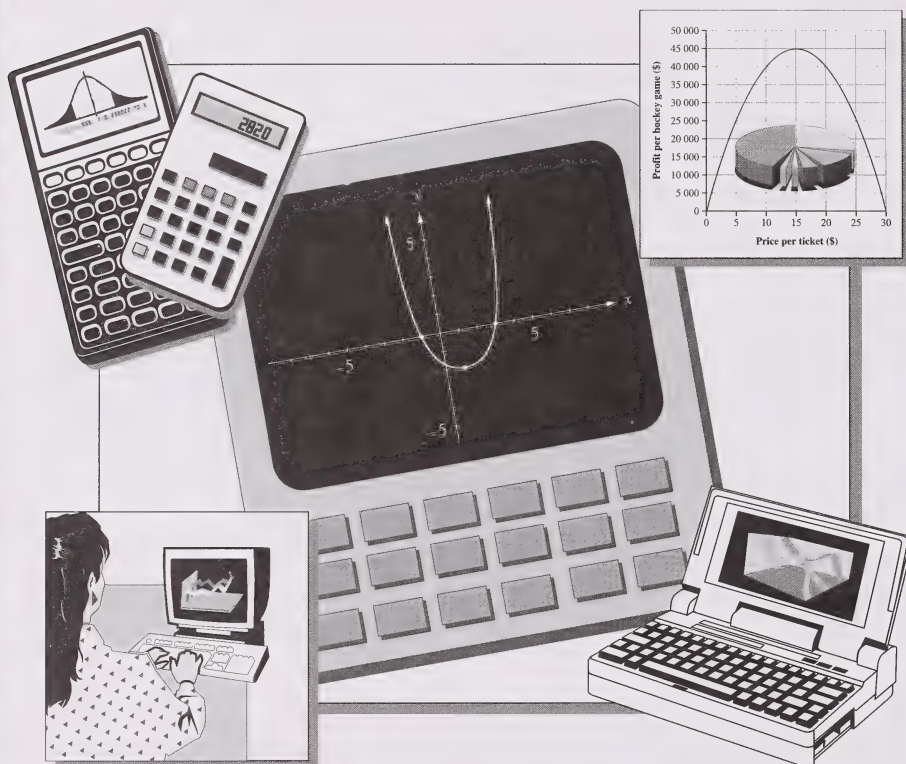
- b. • Calculate the measure of $\angle CDE$ in $\triangle DCE$.

- Calculate the distance, \overline{CD} , from Cadomin Mountain to point D , to the nearest tenth of a kilometre.

- Is the proposed site, P_2 , far enough away from point D to build a coal pit?
Support your answer.

TECHNOLOGY

Technology can be used to display, analyze, interpret, and explore the relationships between tables of values, equations, and graphical representations on a coordinate plane. Use the understanding you have gained from your mathematics course to answer the next set of questions.



23. Which of the following relations can also be classified as a function?

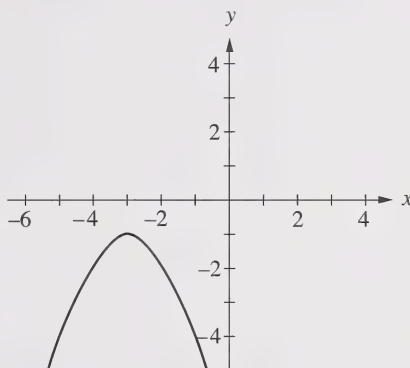
- A. $y^2 = 25 - x^2$
- B. $y = x^2 - x - 2$
- C. $\{(2, 1), (3, 5), (4, 6), (2, 10)\}$
- D. $\{(-4, 8), (-5, 10), (-5, 12), (-6, 14)\}$

24. In the function $f(x) = -2x^2 + 6x + c$, if $f(4) = 6$, then the value of c is

- A. -10
- B. -2
- C. 14
- D. 40

Use the following information to answer the next question.

The graph of a quadratic function $y = a(x + 3)^2 + k$ is shown below.



25. Based on the graph of the function $y = a(x + 3)^2 + k$, the values of a and k must satisfy, respectively,

- A. $a < 0, k > 0$
- B. $a < 0, k < 0$
- C. $a > 0, k > 0$
- D. $a > 0, k < 0$

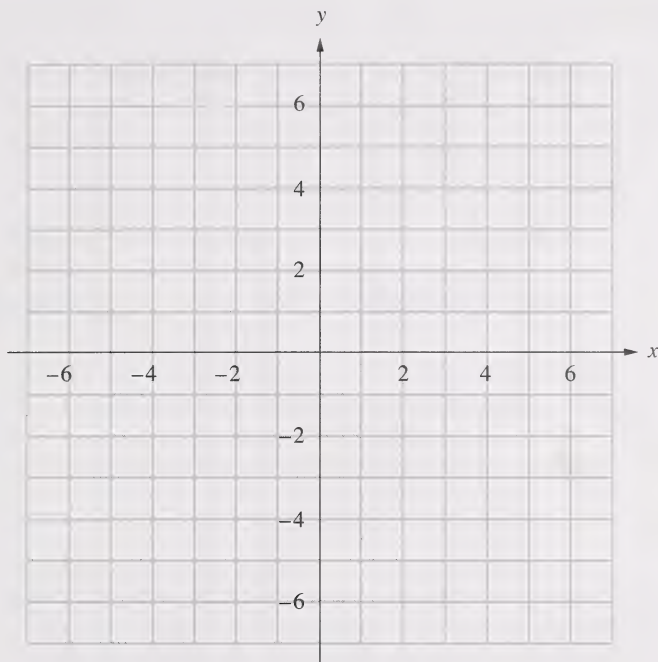
Use the following information to answer the next question.

In order to sketch the graph of the quadratic function $y = -2(x - 1)^2 + 3$, a student needed to analyze some of its graphical characteristics.

Written Response—5 marks

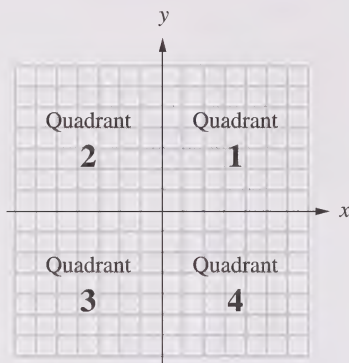
4. a. • For the graph of $y = -2(x - 1)^2 + 3$, the vertex is _____.
- State the y-intercept and the direction of opening of the graph of the function $y = -2(x - 1)^2 + 3$ **and** explain how they can be determined from this function.

- b. Draw the graph of the function $y = -2(x - 1)^2 + 3$ on the coordinate grid below. Label the vertex and the y-intercept.



Use the following information to answer the next question.

To graph the quadratic function $y = -\frac{1}{2}x^2 + 6x - 5$ on the grid below, a student “completed the square” by changing the function into the form $y = -\frac{1}{2}(x - 6)^2 + 13$.



The vertex of the graph of this quadratic function would be in quadrant _____ *i* _____, and the graph would have a maximum of _____ *ii* _____.

26. The row that completes the statement above is row

	<i>i</i>	<i>ii</i>
A.	1	6
B.	2	6
C.	1	13
D.	2	13

Numerical Response

9. If one x -intercept of the graph of the function $y = a(x - 1)^2 - 2$ is $(3, 0)$, then the value of a , to the nearest tenth, is _____.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

To solve the quadratic equation $2x^2 - 615x - 1\,550 = 0$, a student used the quadratic formula and wrote the first two steps, as shown below.

$$\text{Step I} \quad x = \frac{-(-615) \pm \sqrt{(-615)^2 - 4(2)(-1\,550)}}{2(2)}$$

$$\text{Step II} \quad x = \frac{615 \pm \sqrt{390\,625}}{4}$$

Numerical Response

10. If all steps were completed to solve for x , then the **positive** root of $2x^2 - 615x - 1\,550 = 0$, to the nearest whole number, would be _____.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

An angle θ drawn in standard position on a coordinate plane has the following three trigonometric ratios:

$$\tan \theta = -\frac{4}{3}$$

$$\cos \theta = -\frac{3}{5}$$

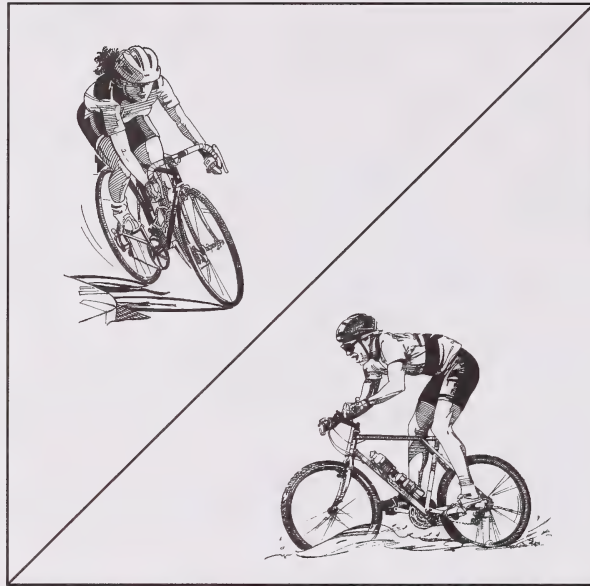
$$\sin \theta = +\frac{4}{5}$$

27. The terminal arm of angle θ must be in quadrant

- A. 1
- B. 2
- C. 3
- D. 4

SPORTS AND RECREATION

Cycling is becoming increasingly popular as both a sport and as a recreational activity. The next set of questions is linked to cycling and bicycles.



Use the following information to answer the next question.

A researcher took 20 random samples of 40 cyclists each and asked them a question requiring a “yes” or “no” answer. The researcher wished to use the “yes” results to predict how the members of the cycling population would respond to the same question.

28. The **best** manner in which to display this data is in a

- A. box plot
 - B. scatter plot
 - C. coordinate plane
 - D. stem-and-leaf diagram
-

Use the following information to answer the next question.

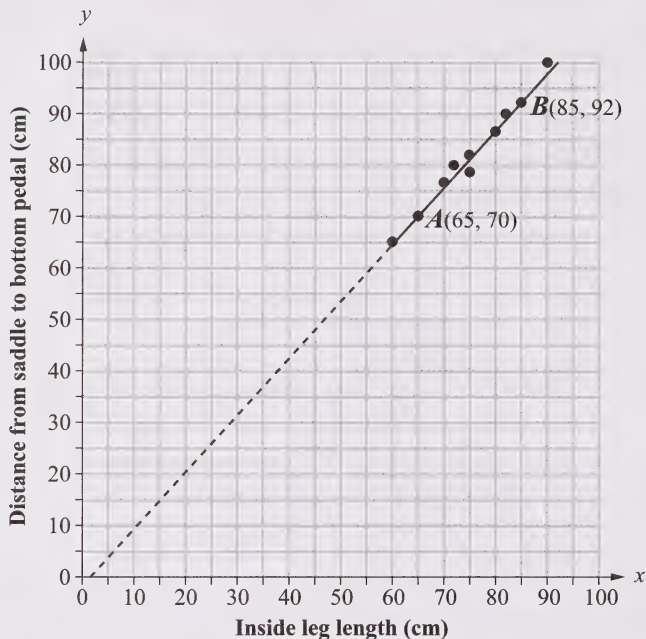
An international mountain bike race drew many spectators from around the world. Of the spectators at this race, approximately 30% came from Europe.

29. Assuming a 90% confidence interval, the expected number of spectators from Europe in a random sample of 80 spectators at this race would be between

- A. 14 and 35
- B. 17 and 31
- C. 20 and 40
- D. 22 and 38

Use the following information to answer the next question.

A researcher found that the power efficiency of racing cyclists is closely linked to saddle height of the bike. The scatter plot below portrays the relationship, in centimetres, between the inside leg length of athletes and the distance from the saddle to the bottom pedal. A line of best fit has been included.



To determine the percentage of the inside leg length that the distance from the saddle to the bottom pedal should be for maximum power efficiency, the researcher needs to find the slope of the line of best fit, m , and multiply by 100.

30. The slope of the line of best fit passing through the two points $A(65, 70)$ and $B(85, 92)$, given as a percentage, is
- A. 91%
 - B. 100%
 - C. 108%
 - D. 110%

Use the following information to answer the next question.

In order to buy some new equipment and tools, the owner of a bike shop planned to take out a \$10 000 loan. He considered the following two loan options.

	Interest Rate	Payment Period
Option I	6% per annum	5 years
Option II	6% per annum	6 years

The monthly payment for option I will be *i* than the monthly payment for option II, and the total amount paid for option I will be *ii* than the total amount paid for option II.

31. The row that completes the statement above is row

	<i>i</i>	<i>ii</i>
A.	less	less
B.	less	more
C.	more	more
D.	more	less

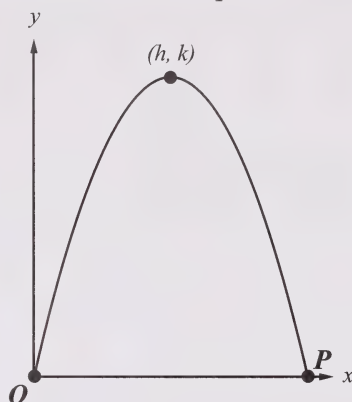
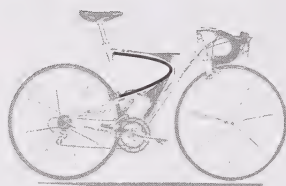
Use the following information to answer the next question.

In order to expand a bike company's facilities, the owner borrowed \$750 000 from a bank over a period of 5 years at an interest rate of 6% per annum.

32. If the monthly payment derived from a table in the data booklet is \$14 473.93, then the type of financial arrangement that the owner made was
- A. a loan
 - B. an annuity
 - C. a mortgage
 - D. a present-value annuity

Use the following information to answer the next two questions.

A bicycle designer developing an aerodynamic bike frame used a parabolic shape, as shown below. To analyze aspects of the parabolic shape, the designer rotated the curve and graphed it on a coordinate plane.



The quadratic function representing the graph of the parabolic shape above is $y = -0.2(x - 12.0)^2 + 28.8$, where x and y are distances, in centimetres.

33. On the graph above, the distance between the two x -intercepts, point O and point P , correct to the nearest tenth of a centimetre, is
- A. 12.0 cm
 - B. 23.0 cm
 - C. 24.0 cm
 - D. 28.8 cm

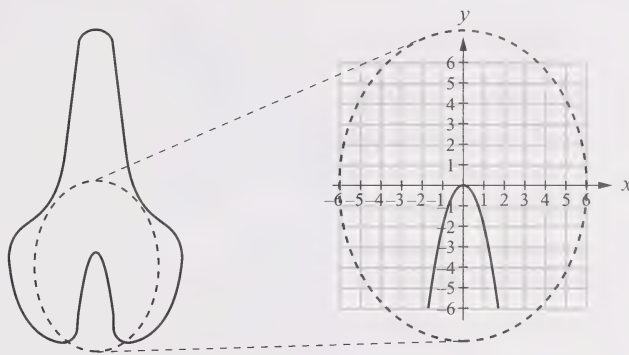
Numerical Response

11. If (h, k) is the vertex of the graph, then the value of k , to the nearest tenth of a centimetre, is _____ cm.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

The back part of a particular bike saddle is in the shape of a parabola. The designer graphed this parabola on the coordinate plane, as shown below.



34. The graph of the back part of the saddle can be represented by the quadratic function

A. $y = -2x^2$

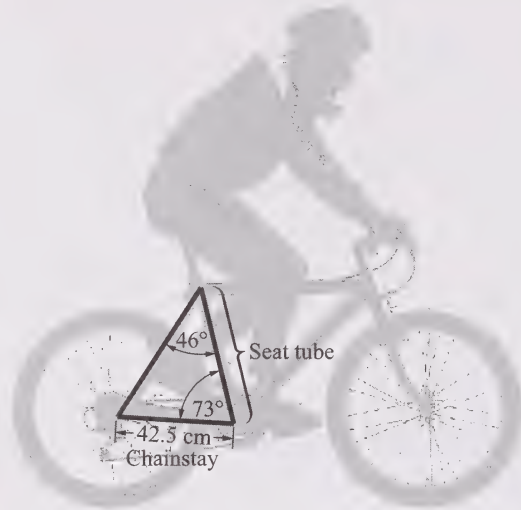
B. $y = 2x^2$

C. $y = \frac{1}{2}x^2$

D. $y = -\frac{1}{2}x^2$

Use the following information to answer the next question.

The length of the chainstay on a particular mountain bike is 42.5 cm and the seat tube angles are 73° and 46° , as shown below.



35. The length of the seat tube, correct to the nearest tenth of a centimetre, is
- A. 32.0 cm
 - B. 37.2 cm
 - C. 51.7 cm
 - D. 56.5 cm

Numerical Response

12. On a particular bike, the chain is 144 cm long. When a pedal makes one complete revolution, it moves through an angle of 360° and through 60 cm of the chain. To move through the entire length of the chain, the pedal must rotate through an angle, to the nearest degree, of _____ $^\circ$.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

The linear relationship between a bike's gear ratio and its speed, in kilometres per hour, if it is being pedalled at a constant rate of 60 revolutions per minute is given below.

	Gear	1st	2nd	3rd	4th	5th
x	Gear ratio	$\frac{50}{25}$	$\frac{50}{20}$	$\frac{50}{15}$	$\frac{50}{12}$	$\frac{50}{10}$
y	Speed (km/h)	16	20	26.7	33.3	40

36. An equation that describes the relationship between the gear ratio, x , and the speed, y , is
- A. $y = -2x$
B. $y = -8x$
C. $y = 2x$
D. $y = 8x$

Use the following information to answer the next question.

Mountain bike races require competitors to climb mountain passes. The following are times recorded for a particular competitor travelling at a constant speed on a pass that is 2 000 m long.

Distance (in metres)	0	250	500	750
Time (minutes)	0	1.17	2.34	3.51

37. If a second competitor had the same conditions on the pass as the first competitor, then the time required for the second competitor to reach the top of this pass, correct to the nearest tenth of a minute, would be
- A. 4.7 min
B. 7.0 min
C. 8.2 min
D. 9.4 min

***You have now completed the examination.
If you have time, you may wish to check your answers.***

Credits

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